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IS 4704 (1985): Silver-tin Dental Amalgam Alloy [MTD 10:  
Precious Metals]

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(Reaffirmed 1995)

*Indian Standard*  
SPECIFICATION FOR  
SILVER-TIN DENTAL AMALGAM ALLOY  
*(First Revision)*

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BUREAU OF INDIAN STANDARDS  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

**AMENDMENT NO. 1 OCTOBER 1991**  
**TO**  
**IS 4704 : 1985 SPECIFICATION FOR SILVER-TIN**  
**DENTAL AMALGAM ALLOY**  
*(First Revision)*

(*Page 5, clause 2.3.7*) — Delete.

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(MTD 10)

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SPECIFICATION FOR  
SILVER-TIN DENTAL AMALGAM ALLOY  
( *First Revision* )

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*Indian Standard*  
**SPECIFICATION FOR  
SILVER-TIN DENTAL AMALGAM ALLOY**  
*( First Revision )*

**0. FOREWORD**

**0.1** This Indian Standard ( First Revision ) was adopted by the Indian Standards Institution on 31 January 1985, after the draft finalized by the Precious Metals Sectional Committee had been approved by the Structural and Metals Division Council.

**0.2** Dental amalgam alloy is composed essentially of silver and tin used for preparing dental amalgam with mercury which is employed in dentistry for restoring decayed teeth. In order that it should serve this purpose, the amalgam alloy should satisfy certain requirements. Need was, therefore, felt for a standard which should lay down requirements, such as chemical composition, time of amalgamation, flow characteristics, etc, for dental amalgam alloys.

**0.3** The standard was first published in 1968. Based upon the experience gained during the years the Committee decided to revise the standard. In this revision the following modifications have been made:

- a) MKS units have been changed to SI units,
- b) Clauses 2.2, 2.3.5, 2.3.6 and A-3.3 regarding chemical composition flow, dimensional change and determination of flow, respectively have been modified.
- c) Clauses 2.3.7 and 2.3.8 regarding compressive strength and tensile strength, respectively have been added.

**0.4** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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\*Rules for rounding off numerical values ( revised ).

## 1. SCOPE

**1.1** This standard lays down requirements for silver-tin dental amalgam alloy.

## 2. REQUIREMENTS

**2.1 Form** — The alloy shall be supplied in the form of filings or shavings which shall be uniform in properties throughout the container and free from foreign material.

### 2.2 Chemical Composition

**2.2.1** The material shall have the chemical composition as follows:

Constituents	Percent
Silver	66.7-74.5
Tin	25.3-27.0
Copper	0.0-6.0
Zinc	0.0-1.9

**2.2.2** The chemical composition shall be determined either by the method specified in IS : 6889-1973\* or any other established instrumental/chemical method. In case of dispute the procedure in the latest edition of IS : 6889 for chemical analysis shall be the referee methods.

**2.2.3** Other elements replacing or in addition to copper and zinc may be used provided the manufacturer submits the composition of the alloy with adequate proof that the alloy containing these other elements will be safe for use in the mouth.

## 2.3 Working Quality

**2.3.1 Polish** — The specimen of amalgam of convenient size prepared in the manner described in A-1 and tested in air-free hydrogen sulphide shall be susceptible to polishing 24 hours after preparation and shall retain this polish for not less than 24 hours.

**2.3.2 Consistency and Soiling Tendency** — The alloy shall form a smooth plastic amalgam which when rubbed against unglazed white paper shall not produce appreciable blackening.

**2.3.3 Carving** — The amalgam shall be susceptible to carving immediately after amalgamation. If after 15 minutes, the amalgam can be easily carved and shows evidence of not hardening promptly, it shall be rejected.

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\*Chemical analysis of silver tin dental alloys.

**2.3.4 Time of Amalgamation** — The amalgam shall be ready for condensing in not more than 90 seconds after trituration is initiated. The method for determining time of amalgamation shall be as described in A-2.

**2.3.5 Flow** — Specimens, of amalgam, when tested in accordance with the method described in A-3, shall not show more than 3 percent reduction in length in a period of 24 hours from the commencement of amalgamation.

**2.3.6** The dimensional change in length of the specimen, when tested in accordance with the method described in A-4 shall not be less than zero and more than 0 to 20 microns/cm at the end of 24 hours and shall not have decreased in length.

**2.3.7** The compressive strength of the amalgam shall be as specified below:

After 1 hour from the preparation	— 55 to 62 MPa
After 6-8 hours from the preparation	— 275 to 413 MPa.

**2.3.8** The tensile strength of the amalgam after 6-8 hours from the preparation shall be from 48 to 62 MPa.

### 3. SAMPLING

**3.1** A separate sample of at least 30 g shall be taken from at least five containers in a lot of 15 kg dental amalgam alloy or part thereof. The individual samples collected from different containers shall be mixed thoroughly to form a composite sample and this shall be tested for various requirements in accordance with 2. The lot shall be accepted if the composite sample passes in respect of all the requirements.

### 4. PACKAGING

**4.1** The alloy shall be packed in a moisture-proof container made of a material which is chemically unaffected by, and does not affect the contents.

### 5. MANUFACTURER'S INSTRUCTIONS

**5.1** Instructions for the use of amalgam shall accompany each package. These instructions shall include the following:

- a) *Proportions* — The ratio of alloy to mercury.
- b) *Trituration* — The method of triturating the amalgam shall be specified for hand trituration by stating the size, shape, design and the material of which the mortar and pestle, are constructed,

and the load exerted on the pestle, the approximate revolutions per minute at which the pestle is revolved and the time required for a mix containing approximately 0.4 g of alloy and the recommended amount of mercury.

Other methods of trituration may be specified by the manufacturer providing the instructions in sufficient detail to give reproducible test date for the specification test procedures.

- c) *Condensing* — Details relating to condensing shall include when and how the excess mercury is to be expressed and the method of packing for small and large restorations.
- d) *Precautions* — If the alloy used in making the amalgam contains zinc in sufficient quantity to cause the gaseous dissociation of water, the following precaution shall be printed in type larger than that in the body of the instructions.

The alloy contains zinc and the amalgam made therefrom will show excessive corrosion and expansion if moisture is introduced during mixing and packing of the amalgam. Therefore, the amalgam should not be mulled in or touched with bare hands, condensed in a wet cavity or contaminated with moisture in any manner.

## 6. MARKING

**6.1** Each container shall be clearly marked with the following information:

- a) Name or trade-mark of the manufacturer,
- b) Batch number indicating date of manufacture ( year and month ), and
- c) Minimum net mass in grams.

**6.1.1** The product may also be marked with Standard Mark.

**6.1.2** The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

## APPENDIX A

( Clauses 2.3.1, 2.3.4, 2.3.5 and 2.3.6 )

### TESTING OF SILVER-TIN DENTAL AMALGAM ALLOY

#### A-1. PREPARATION OF TEST SPECIMENS

**A-1.1 Amalgam for Test Specimens** — Amalgam for the test specimens shall be prepared from the test sample in accordance with the manufacturer's instruction as supplied with the material, except that a glass pestle and a mortar with an inside mound ( raised centre ) having properly-ground surfaces shall be used.

**NOTE** — Working surfaces of the pestle and mortar should be prepared by wet grinding with silicon carbide powder of particle size of about 25 microns.

**A-1.2 Mercury for Amalgam** — Dental mercury as specified in IS : 4705-1985\* shall be used for the purpose of amalgamation.

**A-1.3 Condensation** — The test specimens shall then be prepared using as far as possible the procedure specified by the manufacturer, by condensing the amalgam into a rigid die maintained at  $37.0 \pm 1.0^{\circ}\text{C}$  ( except during the packing of the specimen ) and having a cavity of the dimensions prescribed for the specimens.

**A-1.4** The amalgam shall be condensed in successive layers approximately 2 mm thick using a smooth, flat-faced plugger of 3 mm diameter. Each successive layer shall be subjected to 5 vertical strokes of the plugger operated with a load of 45 N.

#### A-2. DETERMINATION OF AMALGAMATION TIME

**A-2.1 Procedure** — Triturate 0.4 g of the test sample ( see 3.1 ) of alloy with appropriate quantity of dental mercury as specified in IS : 4705-1985\* at  $23^{\circ} \pm 2^{\circ}\text{C}$ . The time lapsed between the beginning of the trituration and the time that the amalgam is ready for packing, shall be considered the time of amalgamation.

**A-2.2** The amalgam shall be considered suitable for packing when it clings to the sides of the mortar and is a smooth continuous mass.

#### A-3. DETERMINATION OF FLOW

**A-3.1 Preparation of Cylindrical Specimen** — The specimen shall be a cylinder 4 mm in diameter and 8 mm long which shall be prepared in the manner described in A-1 by condensing the amalgam into a rigid

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\*Specification for dental mercury ( first revision ).

steel die having a cavity 5 mm in diameter and approximately 10 mm long. The specimen shall be removed from the die on completion of condensing and shall then be transferred to an environment of  $37^\circ \pm 1^\circ\text{C}$ .

**A-3.2** Before application of the axial load, the ends shall be surfaced at right angle to the cylinder axis so that the length of the specimen is 8 mm. Three hours after amalgamation has been started, the specimen shall be subjected to constant axial load of  $10.5 \pm 0.1 \text{ MPa}$ . This load shall be maintained for 24 hours, the change in length of each specimen shall then be determined.

**A-3.3** During this test, the temperature of the specimen shall be maintained at  $37^\circ \pm 1^\circ\text{C}$ .

**A-3.4** The reduction in length of the specimen shall be calculated as a percentage of the original length, and the average of the values obtained from two specimens shall be reported as the flow.

Note — 1 MPa =  $0.102 \text{ kgf/mm}^2$ .

#### **A-4. DETERMINATION OF DIMENSIONAL CHANGE DURING HARDENING**

**A-4.1 Preparation of Cylindrical Specimen** — The specimen shall be approximately 5 mm in diameter and 10 mm long and shall be prepared in the manner described in A-1. The specimen shall be removed from the die as soon as condensation is complete and not later than 10 minutes from the start of mixing. The specimen shall then be transferred to an environment of  $37^\circ \pm 1^\circ\text{C}$ . The specimen shall be placed in the measuring instrument and shall not be subjected to restraint during the test.

**A-4.2** The initial measurement shall be made 15 minutes after the start of mixing. The final measurement shall be made at the end of 24 hours. During the test, the temperature of the specimen shall be maintained at  $37^\circ \pm 1^\circ\text{C}$ .

**A-4.3** The average in change length of two such specimens shall be reported as dimensional change during hardening.

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